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NPIC/TSSG/DED-1639-69

3 June 1969

MEMORANDUM FOR : Chief, Development & Engineering Division, TSSG

SUBJECT : Requirements for the ORD Electro-Optical Image-Processing Equipment

REFERENCE : Memorandum, Subject: Preliminary Engineering Survey of a Proposed Image Analysis Laboratory

### 1. Situation

The introduction of the new acquisition systems will cause a substantial increase in the quantity and quality of photographic images available during a given period for interpretation. As a consequence, each step of the exploitation process, with the exception of the PI's judgment, is under analysis with a view toward automation. In this respect one of the most promising techniques is that of electro-optical image processing; i.e., quantitative image manipulation using optical systems, electronic scanners, and computers. Although some research on restoration of marginal quality images has been performed under contract, the requirements for practical application in NPIC remain to be determined. Much of the applied research necessary to accomplish this, exclusive of computer requirements, can be performed in-house, provided appropriate input and output devices are procured. The equipment under development by ORD for their research program in image-processing is of the type required.

### 2. Facts Bearing on the Situation

- a. There are three basic components of an image processing system; i.e., (1) input device, (2) data processor, usually a computer, (3) output or display unit - ORD has an input and output device under construction.
- b. The ORD image-processing research program may terminate this Fall.
- c. The input and output devices for the ORD program will be completed during 1969. They were designed for the type of research NPIC must undertake when investigating the applications and feasibility of image processing. Acquisition of the ORD devices would represent a significant savings to NPIC in time and money.

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SUBJECT : Requirements for the ORD Electro-Optical Image-Processing Equipment

d. The software developed by ORD was written for the [ ] series computer. While compatible with the majority of other software in this field (i.e., JPL, [ ] Defense Research Labs), it is not compatible with the computers used by NPIC; therefore, 360 computer time required for in-house efforts will have to be arranged locally.

e. Lack of an on-line computer interface will increase experimental time and restrict the range of problems to be investigated, but will not prohibit valuable investigations in some areas.

f. Image processing in some form will be required at NPIC in the future if we are to cope with the increased volume of imagery. It will be necessary then, as now, to enhance and restore to the extent possible, marginal quality images of critical areas.

g. Present image processing facilities at NPIC are suitable for only theoretical investigations. Work on applied research operational applications requires input/output equipment of the type designed by ORD and the availability of a 360 system computer.

h. This equipment can also be used for image analysis research.

i. Initial personnel requirements can be met in-house with some T&M contract assistance. As the image-processing program develops, an engineer or physicist with experience in optics and electronic communications will be required.

j. The ORD input device, made by [ ] is a specially constructed rapid isodensitracer. It requires [ ] worth of modifications before it will operate satisfactorily. A contract has been funded to accomplish this work and the equipment is at [ ]

k. The output, or display device, is presently under construction by [ ] It will provide a high quality display and a special CRT from which images on film may be exposed. Approximately [ ] of effort remains on this project.

l. The physical plant and ancillary computer equipments requirements are discussed in the reference.

m. There is no facility presently equipped or cleared to investigate electro-optical image processing applied to the needs of NPIC.

n. The subject equipment would permit limited support for present operational requirements, though not designed for this purpose.

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3. Areas to be Investigated Using the ORD or Similar Equipment

a. Image Processing

- (1) Complete the stationarity & linearity experiments begun by ORD.
- (2) Comparison of digital vs. optical processing of images.
- (3) Image Enhancement studies.
- (4) Restoration of degraded images.
- (5) Tone reproduction requirements of microimages-linear and nonlinear.
- (6) Signal-to-noise ratio as a measure of image quality.
- (7) Shaded aperture analysis-applications to image processing.
- (8) Digital generation of spatial filter parameters for optical data processors.
- (9) Gray level and resolution requirements for line-scanned imagery.
- (10) Investigation of the information transfer characteristics in the interpretation process.
- (11) Investigation of operational areas suitable for automation by image processing techniques, e.g.,
  - (a) target change detection,
  - (b) target recognition, identification,
  - (c) automatic density measurement.
- (12) Image spectral analysis and its effect on the interpretation process.

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b. Image Analysis Research Program

- (1) Determine the effects of non-linear development on image tone-reproduction.
- (2) Investigate the effective exposure hypothesis.
- (3) Investigate microimage sensitometry.
- (4) Determine the relationship between image resolving power and the modulation transfer function.
- (5) Determine the number of gray levels possible with operational films when digitized (film dynamic range).
- (6) Establish image parameters for imagery to be processed digitally and optically.
- (7) Investigate non-linear transfer function analysis.

4. Conclusions

a. Additional in-house applied research on the applications of image processing to NPIC needs is essential. The ORD input and output devices would constitute a major adjunct to our present capability.

b. Each project listed in paragraph 3 involves an extensive series of experiments vital to NPIC requirements.

c. In the long run a dedicated computer will be required if image processing is to achieve its full operational and research potential.

d. After the calibration of an in-house image processing facility, limited operational support could be provided; e.g., edge enhancement, restoration of images degraded by motion and/or focus errors.



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(3 June 1969)

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25X1

25X1

ORD 2886-69

28 APR 1969

25X1

MEMORANDUM FOR:

[redacted] Chief/EL/ESD/TSSG/NPIC

SUBJECT:

Preliminary Engineering Survey of a  
Proposed Image Analysis Laboratory

25X1

[redacted] Equipment)

25X1

1. At your request the undersigned have conducted a preliminary engineering survey to determine technical feasibility in installing the ORD Image Analysis Laboratory in room 4N806A of [redacted]. The results of this survey as outlined below indicate some instrument modification and minor room alterations will be required to place the laboratory into operation.

2. The major consideration must be the instrument modification. The system has been designed to operate on-line with an IBM 360 system computer, but because an adequate computer is not convenient to room 4N806A, it is recommended that the computer interface be replaced by a standard magnetic tape deck. The total cost of this modification is estimated to be:

Purchase price of a Honeywell tape  
and drive . . . . .  
Design and fabrication of an IDT  
interface . . . . .  
Total



25X1

in addition to funds already committed to the program.

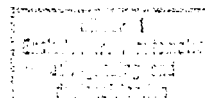
25X1

3. A second consideration is the building modification required to support the system. [redacted] of

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[redacted] was consulted in this regard and his recommendations are attached. The floor loading capacity of 125 psi is more than adequate for the ORD system (gross weight 3900#) plus image analysis equipment currently in room 4N806A. Additional airconditioning will be required to dissipate the heat generated by the electronics in order for the system to function properly. Additional electrical circuits should be installed to carry the estimated 100 amps drawn by the system.

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The total cost for these building modifications is an estimated [REDACTED]

4. An aircompressor is required by the IDT air bearings. The large compressor now in use could be moved with the IDT and reinstalled in a room remote to the clean area, or a smaller unit capable of supplying at least 100 psi at 20 cfm used instead. An illustration of the present pump is attached.

5. The size of the room is adequate to contain the Image Analysis Laboratory together with the [REDACTED] microdensitometer and IDIOT system as indicated in the suggested room lay-out attached.

6. This study was conducted to establish the technical feasibility of one possible site out of many for the laboratory and does not imply an official ORD decision on the actual site of installation. The project officer is [REDACTED], Optics/Office of Research and Development, extension [REDACTED]

EL/ESD/TSSG/NPIC

CONCUR:

O/ORD

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# PRELIMINARY INVESTIGATION

Room 4N806A

## ARCHITECTURAL

The existing ceiling will have to be cut and patched to accommodate the new mechanical and electrical system components.

## ELECTRICAL

The new equipment requires a new 100 amp., 120 volt panel. This will be run from a new circuit breaker attached in the electric closet on the north riser on the fourth floor, and extended over the ceiling to a new panel in the room. There will also be a new 3 KW heater in the mechanical system modifications.

## MECHANICAL

The room is presently air conditioned from a double duct, high velocity mixing box supplying approximately 200 cfm to the room thru a 24x24 perforated diffuser thru an absolute filter. The air leaves the space thru a lightproof louver in the door. Access to the mixing box is thru a door in the plaster ceiling. The mixing box is at the end of the branch line serving the area.

The new equipment to be located in the space will increase the air conditioning requirements far beyond the capacity of the existing mixing box or the branch ducts in the vicinity. There is a 12" diameter cold branch duct running above the ceiling of the space that serves only the air shower. The proposed scheme for properly cooling and filtering the air to the space is as follows:

- (1) Remove the existing mixing box and associated ductwork and controls including space thermostat.
- (2) Install new 1000 cfm variable volume box with 3KW electric reheat coil. Connect inlet to existing 12" diameter cold duct.
- (3) Box shall discharge thru flexible duct, plenum, absolute filter, and 24x24 curved adjustable blade ceiling grille to space.
- (4) Room temperature shall be controlled by a sensing element located in the center of the supply grille and a controller mounted on the mixing box.
- (5) Relief of air from space shall be by means of a transfer duct to exit corridor outside of air shower.

The installation of the new variable volume box will require partial removal and replacement of the plaster ceiling.

## COST ESTIMATE

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Electrical

Mechanical

Architectural

25X1

TOTAL

25X1

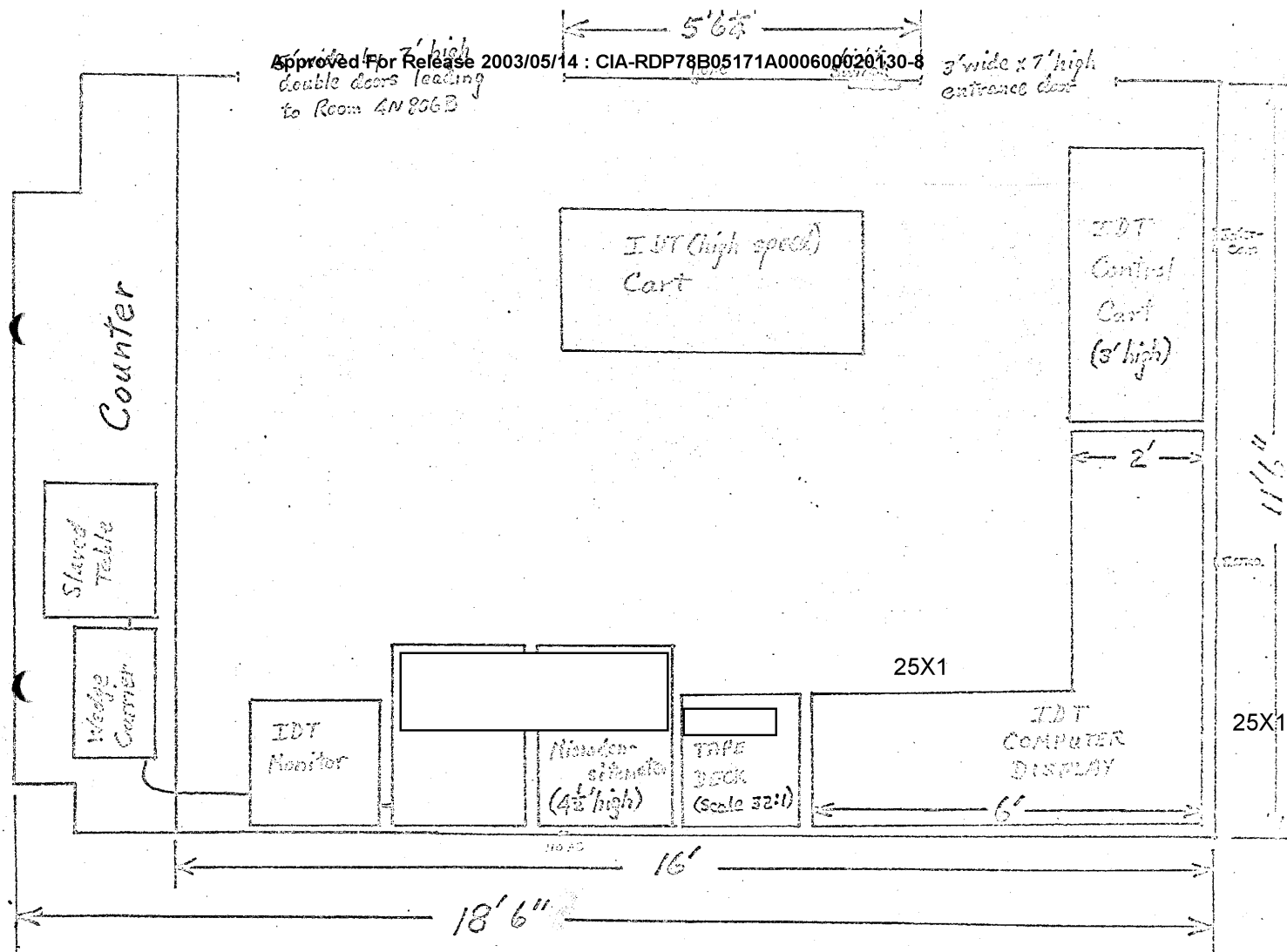
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Scale 24" = 1'